How radiative fluxes are affected by cloud and particle characteristics

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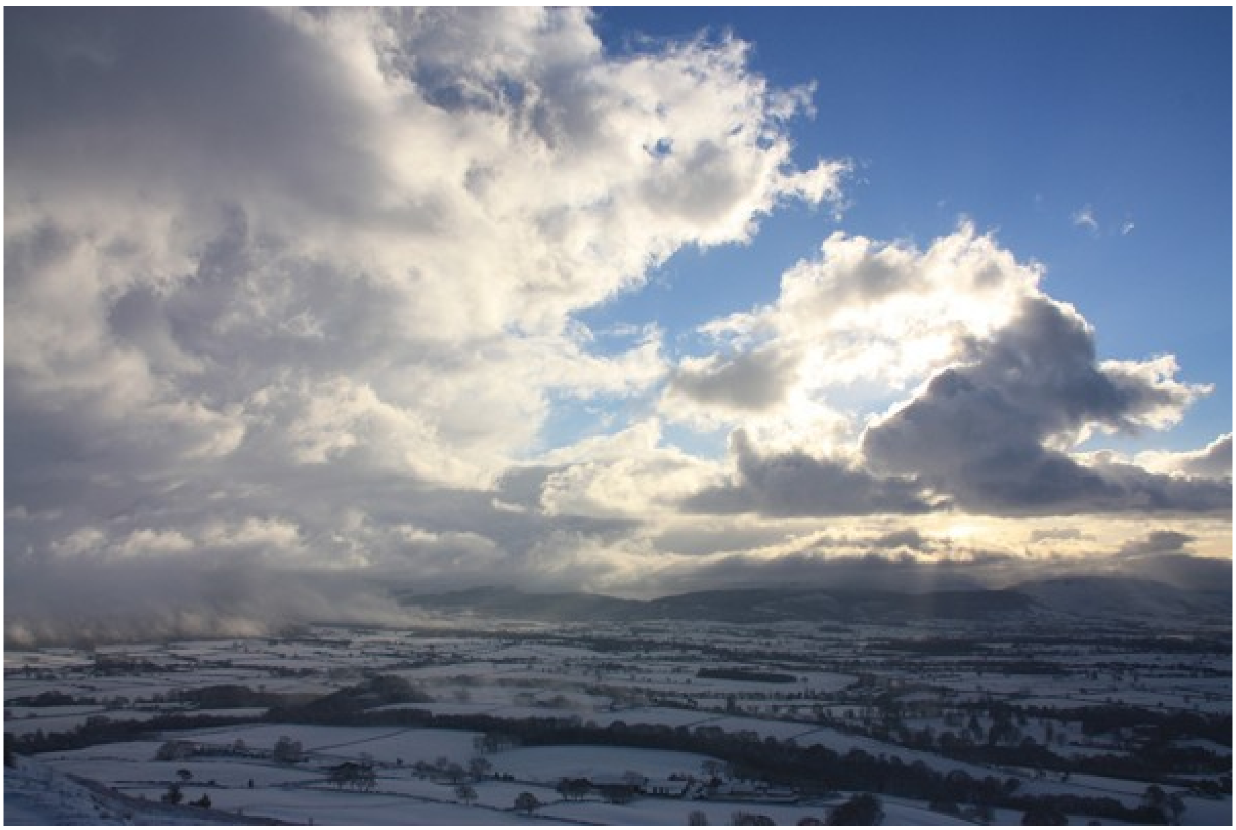

Researchers investigated the sensitivity of net radiative fluxes at the top of the atmosphere to 16 parameters related to cloud and aerosol representations in the Community Atmosphere Model version 5. They found that cloud parameters—especially the one changing cloud ice to snow—are the primary culprits affecting energy flux among these parameters. Credit: James Burke (Flickr) via a Creative Commons License

To understand how the Earth will change as emissions from fossil fuel combustion change, climate models calculate a complex and changing mix of clouds and emissions that interact with solar energy. To narrow the range of possible answers from these calculations in the Community Atmosphere Model version 5 (CAM5), researchers analyzed the effect of 16 parameters, proven numerical stand-ins for atmospheric processes, on the flux of energy at the top of the atmosphere. They found that the flux of energy entering and exiting the top of the atmosphere is the main driver of surface temperature change.

This study narrows the broad range of possible answers provided by climate models, or improves the understanding of parameter uncertainties, in CAM5. Thus, it provides information for further calibrating model parameters with the largest sensitivity.

The research team, led by U.S. Department of Energy scientists at Pacific Northwest National Laboratory, found that the global mean radiative flux (FNET) variance is dominated by the cloud forcing variance, given the assigned uncertain parameter ranges. They also found that most selected cloud microphysics- and emission-related parameters have statistically significant impacts on the global mean FNET. Three cloud microphysics parameters (associated with the fall speed of cloud ice and snow) and assumed bounds on cloud droplet number have a smaller impact than the size threshold required for ice to change to snow. Overall, these cloud microphysics-related parameters have a larger impact on high clouds than on low clouds. The team's comprehensive approach not only estimates the contribution of each parameter to model sensitivity but also provides its statistical significance. This is an important quantification, rarely obtained due to the limited sampled space of parameter uncertainty.

More information: "A sensitivity study of radiative fluxes at the top of atmosphere to cloud-microphysics and aerosol parameters in the

Community Atmosphere Model CAM5." *Atmospheric Chemistry and Physics* 13, 10969–1098 (2013). DOI: 10.5194/acp-13-10969-2013.

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